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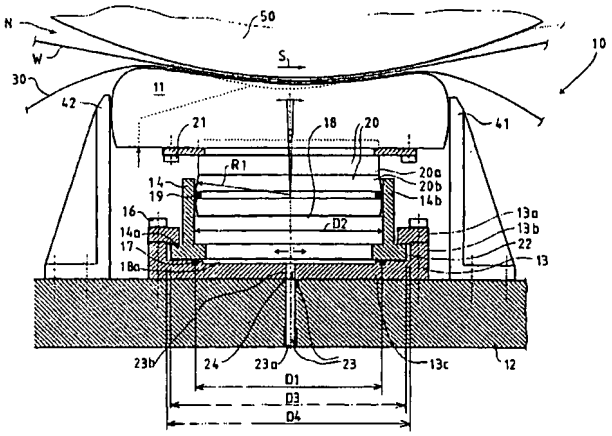
(54) Title: EXTENDED NIP PRESS FOR A PAPER OR BOARD MACHINE



(57) Abstract: An extended nip (N) is formed between a counter roll (50) and a shoe roll (10), which shoe roll (10) comprises a stationary support structure (12) and a flexible shell (30) rotating around it. The shell (30) is supported at its inner surface on the support structure (12) by means of a press shoe (11) and associated loading members (14, 20, 114, 120) spaced from one another in a direction transverse to the machine direction and situated in at least one row. The loading members comprise a first cylinder (14) supported on the support structure (12) and a piston (20, 120) disposed in the first cylinder, in which connection the press shoe (11) and the shell (30) surrounding it can be loaded against the counter roll (50) by means of said loading members. The first cylinder (14) is disposed in a cylindrical base part (13) so as to be movable in a plane perpendicular to the centre axis of the first cylinder (14), which base part (13) is attached to the support structure (12). The first cylinder (14) is additionally relieved in the radial direction by means of a pressure medium supplied into a pressure chamber (18, 118) of the first cylinder (14), by which pressure medium the press shoe (11) is also loaded.

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Extended nip press for a paper or board machine

The invention relates to an extended nip press for a paper or board machine according to the preamble of claim 1.

One problem associated with extended nip presses arises from different thermal expansion movements caused by different temperatures of a press shoe and a support structure receiving a loading force. In a situation in which the temperature of a press shoe in a ten-metre-wide machine is about 50 °C higher than the temperature of a support structure, at the ends of the press shoe made of steel and supported in the middle, an elongation of about 2.5 mm is produced in relation to the support structure. The thermal expansion movement of the loading shoe which is greater than that of the support structure causes lateral forces acting on cylinder-piston members supporting the press shoe, friction forces arising from the lateral forces and possible bending of the press shoe. The above-mentioned things in turn give rise to inaccuracy of compression loads and faults in the moisture profile.

Prior art publications have proposed many different solutions to this problem. In the following, a few such prior art solutions are described.

The applicant's **EP patent 933 471** discloses one extended nip press of a paper or board machine. The press shoe of the press has been supported on a support structure by means of several articulated hydraulic loading cylinders. Each loading cylinder comprises a piston and a first cylinder attached to the press shoe and a second cylinder attached to the support structure. The opposite end portions of the piston are slidably and sealingly disposed in said cylinders, whereby pressure spaces are provided in the cylinders under the opposite end surfaces of the piston. The press shoe can be loaded against a counter roll by means of a

pressure medium passed into the pressure spaces. In this kind of arrangement, the piston is able to pivot with respect to both cylinders about axes parallel and perpendicular to the machine direction. This allows deformations and thermal expansion of the press shoe and enables the press shoe to pivot about an axis perpendicular to the machine direction.

The applicant's **EP patent 345 501** discloses a second extended nip press of a paper or board machine. The press shoe of the press has been supported at the bottom surface thereof onto a support structure of a roll by means of two rows of cylinder-piston actuators in the axial direction of the roll. The support is provided between the rounded outer ends of piston pins attached to the pistons and the bottom surface of the press shoe. In addition, a row of sleeves has been attached to the support structure between the rows of piston pins, said sleeves extending into bores formed in the press shoe. The sleeves have been disposed in the bores of the press shoes by means of resilient seals. The press shoe has been additionally supported in the machine direction at one edge thereof on a support member provided on the support structure by means of a roller member, which receives the horizontal forces acting on the press shoe. Thus, the press shoe rests floatingly on the piston pins, thereby allowing a small axial movement and inclination of the press shoe.

The applicant's **DE utility model 298 17 097 U1** discloses a third extended nip press of a paper or board machine. The cylinder-piston actuator loading the press shoe of the press comprises a piston which has been detachably attached to a support structure and sealingly disposed in a cylinder supported on the press shoe. The loading shoe has been disposed on the bottom plate of the cylinder so that it is movable in a horizontal plane. Fig. 2 shows an embodiment in which the bottom plate of the cylinder and the walls of the cylinder define a chamber that opens towards the bottom surface of the press shoe. Said chamber and a hydrostatic pressure chamber situated in the frontal face of the press shoe are supplied with a pressure medium from a common pressure medium source, in which connection

both chambers have the same pressure. The pressure of the hydrostatic pressure chamber is generally about 50 to 70 % of the pressure in the pressure space of the loading cylinder, in which connection, depending of areas, about 30 to 50 % of the radial load acting on the cylinder is not compensated for. Thus, the compression force between the press shoe and the cylinder varies according to the loading situation of the loading cylinder, in which connection between the press shoe and the cylinder there may occur even great friction forces, which prevent lateral displacement of the press shoe with respect to the cylinder. The side edge of the piston fitted in the cylinder is curved, so that the cylinder is able to pivot to some extent with respect to the piston. The actual invention here relates to the fact that the piston has been attached to the support structure eccentrically. By loosening the attachment of the piston and by changing the position of eccentric attachment pieces, the piston and thereby also the cylinder can be moved in the machine direction with respect to the press shoe. By this means, the pressure profile applied to the web running through the press can be changed, thereby allowing an optimal profile to be achieved for different paper and board grades.

US patent 5,688,375 (Voith) discloses a fourth extended nip press of a paper or board machine. The cylinder-piston actuator loading the press shoe of the press is formed of a cylinder provided in a support structure and having a piston disposed therein. The lower part of the piston comprises a projection portion which is sealed against the walls of the cylinder by means of seals. The piston defines at its lower part a first pressure chamber that opens into the cylinder. In addition, the piston defines at its upper part a second pressure chamber that opens into the bottom surface of the press shoe and which is in communication with the first pressure chamber through a capillary passage. The piston has been sealed at its edges against the bottom surface of the press shoe by means of seals. A pressure medium flows through the capillary passage under substantially constant conditions from the first pressure chamber into the second pressure chamber and thus to the bottom surface of the press shoe. When the press shoe tilts, some pressure medium can escape from the second pressure chamber, in which

connection a sufficient amount of replacement pressure medium cannot rapidly flow out of the first pressure chamber along the capillary passage. As a result of this, the pressure in the second pressure chamber drops, and the piston applies itself with respect to the bottom surface of the press shoe by means of the pressure acting in the first pressure chamber.

It is an object of the present invention to provide an extended nip press for a paper or board machine wherein the inaccuracies of load, tilt and profiles caused by thermal expansion and friction forces are avoided.

The extended nip press of a paper or board machine according to the invention is mainly characterised in that which is set forth in the characterising part of claim 1.

In the extended nip press according to the invention, movement between the press shoe and the support structure is allowed. The structure according to the invention additionally enables low-friction and precise positioning and loading of the press shoe against a counter roll as well as sensitive adjustment of tilt.

In the following, the invention will be described in detail with reference to the different embodiments of the invention shown in the figures of the appended drawing, to the details of which embodiments the invention is, however, not meant to be exclusively confined.

Figure 1 schematically shows one embodiment of the structure of the extended nip press according to the invention, viewed in the machine direction.

Figure 2 shows an enlarged detail from Fig. 1.

Figure 3 schematically shows a second embodiment of the structure of the extended nip press according to the invention, viewed in the machine direction.

Figure 4 shows an enlarged detail from Fig. 3.

Figure 5 schematically shows the structure of the extended nip press shown in Fig. 1, viewed in a direction transverse to the machine direction, in a situation in which the press shoe is loaded by one cylinder row.

Figure 6 schematically shows a third embodiment of the structure of the extended nip press according to the invention, viewed in a direction transverse to the machine direction.

Figure 7 schematically shows the structure of the extended nip press shown in Fig. 1, viewed in a direction transverse to the machine direction, in a situation in which the press shoe is loaded by two cylinder rows.

Fig. 1 is a schematic view of a loading arrangement between a press shoe 11 and a stationary support structure 12, viewed in the machine direction. The loading arrangement comprises a base part 13 attached to the support structure 12. The base part 13 comprises an annular portion 13a, a cylindrical portion 13b and a bottom plate 13c, which closes the lower end of the cylindrical portion 13b. Here, the cylindrical portion 13b and the bottom plate 13c of the base part 13 are formed of a single piece and the annular portion 13a is formed of a separate piece. The cross section of the wall of a first cylinder 14 disposed in the base part 13 is substantially in the shape of an inverted letter T comprising a horizontal arm 14a forming the lower part of the wall and a vertical arm 14b forming the upper part of the wall. The inside diameter D4 of the cylindrical portion 13b of the base part 13 is slightly larger, advantageously about 6-10 mm larger, than the outside diameter D3 of the horizontal arm 14a of the first cylinder 14 disposed in the base part 13. The first cylinder 14 is locked in the radial direction by means of the annular portion 13a of the base part 13, which annular portion is positioned about the first cylinder 14 on the horizontal arm 14a and supported on the upper end surface of the cylindrical portion 13b, while the first cylinder 14 is able to move in

a direction transverse to the centre axis Y2 of the first cylinder 14 in a housing 22 defined in the base part 13 and provided with a suitable clearance space.

The bottom plate 13c of the base part 13 receiving the first cylinder 14 has a cylindrical recess 18a, which extends at least some distance under the horizontal arm 14a of the wall of the first cylinder 14. By this means it is ensured that the pressure medium introduced into said recess 18a can pass under the horizontal arm 14a of the first cylinder 14. The horizontal arm 14a of the first cylinder 14 is sealed against the bottom plate 13c of the base part 13 by means of an annular seal 17. The centre diameter D1 of the annular seal 17 fitted to the bottom plate 13c of the base part 13 is approximately equal to the inside diameter defined by the vertical wall 14b of the first cylinder 14, i.e. the inside diameter D2 of a chamber 18 receiving a piston 20 disposed in the first cylinder 14. Thus, the pressure medium is able to be effective on the bottom surface of the horizontal arm 14a of the first cylinder 14 over an area which is approximately equal to that area on the top surface of the horizontal arm 14a on which the pressure medium is effective. This kind of arrangement allows the first cylinder 14 to be relieved in the radial direction such that the friction between the backing surfaces of the first cylinder 14 and the base part 13 can be minimised. As a result of this, the first cylinder 14 can freely move, when needed, in a plane perpendicular to the centre axis Y2 of the first cylinder 14 in the housing 22 formed in the base part 13 and provided with a suitable clearance space. The relationship between the centre diameter D1 of the seal and the inside diameter D2 of the cylinder should be in a range of ± 10 %, advantageously in a range of ± 5 %. If said relationship is in a range of ± 5 %, the difference between the above-mentioned pressurised upper and lower areas of the horizontal arm 14a of the first cylinder 14 would be about ± 10 % and the radial force preventing lateral movement and causing a friction force would be at the most about 10 % of the cylinder force. When using a friction coefficient of 0.3, the friction force offering resistance to the lateral movement of the first cylinder 14 would then be at the most about 3 % of the cylinder force.

A pressure medium is passed into the pressure chamber 18 under the piston 20 disposed inside the first cylinder 14 via a pressure medium duct 23, which is formed of a pressure medium flow opening 23b which extends through the bottom plate 13c of the base part 13 and of a pressure medium flow opening 23a which is provided in the support structure 12 and to which the pressure medium flow opening 23b extending through the bottom plate 13c of the base part 13 is sealed by means of an annular seal 24. The pressure medium flow opening 23b extending through the bottom plate 13c of the base part 13 is situated substantially in the middle of the bottom plate 13c of the base part 13 and opens into the cylindrical recess 18a in the lower part of the pressure chamber 18.

The piston 20 disposed inside the first cylinder 14 comprises a portion 20a attached to the press shoe 11 by attachment means, for example, by bolts 21 and a portion 20b situated under it and provided with planar top and bottom surfaces and with a spherical side surface. The radius of curvature of the spherical side surface of the piston 20 has been denoted with the reference sign R1. The piston 20 portion 20b provided with a spherical side surface is sealed against the inner surface of the vertical wall 14b of the first cylinder 14 by means of an annular seal 19 situated at the widest point of the side surface. Because of the spherical side surface of the piston 20, the piston 20 can incline with respect to the first cylinder 14. This structure allows an inclination of the piston 20 in a range of about 3-5°.

In the situation illustrated in Fig. 1, the first cylinder 14 is situated in the middle of the housing 22 defined in the base part 13. In that case, the vertical centre axis Y1 of the base part 13 coincides with the centre axis Y2 of the first cylinder 14.

Fig. 2 shows an enlarged detail of the area where the first cylinder 14, the base part 13 and the support structure 12 shown in Fig. 1 are connected. The enlargement shows that the base part 13 is attached to the support structure 12 by attachment means, for example, by bolts 16 extending through the annular portion 13a of the base part 13 and the cylindrical portion 13b of the base part. The

enlargement also shows that the recess 18a formed in the bottom plate 13a of the base part 13 extends as a narrow slit 15 right up to the seal 17. This assures that the pressure medium can be effective right up to the seal 17 and that the seal 17 nevertheless has a sufficient support surface on both the inner and the outer circumference. In order that no friction forces caused by the radial forces resisting lateral movement should be directed at the first cylinder 14, the effective pressurised diameter D1 of the recess 18a of the bottom part 13a should be equal to the inside diameter D2 of the first cylinder 14. Depending on the seal type, it is difficult to provide a totally accurate and correct effective diameter, but in the case of the so-called O-ring seal shown in the figures the centre line diameter D1 of the seal 17 is approximately the correct effective diameter.

Fig. 3 is a schematic view of an alternative loading arrangement between the press shoe 11 and the stationary support structure 12, viewed in the machine direction. The loading arrangement shown in Fig. 3 differs from the loading arrangement shown in Fig. 1 in respect of the base part 13. The base part 13 does not comprise any bottom plate at all, but, instead, the first cylinder 14 is sealed directly against the top surface of the support structure 12 by means of an annular seal 17 disposed in the bottom surface of the horizontal arm 14a of the first cylinder 14. The base part 13 comprises in this embodiment a cylindrical portion 13b surrounding the horizontal arm 14a of the first cylinder 14 and an annular portion 13a positioned on the horizontal arm 14a of the first cylinder 14. The cylindrical portion 13b and the annular portion 13a are formed here of one piece. The first cylinder 14 can move in a plane perpendicular to the centre axis Y2 of the first cylinder 14 in a housing 22 which is defined by the support structure 12 and the base part 13 and provided with suitable clearance spaces.

Fig. 4 shows an enlarged detail of the area where the first cylinder 14, the base part 13 and the support structure 12 shown in Fig. 3 are connected. The enlargement shows that there is a slit 15 extending to the seal 17 between the bottom surface of the horizontal arm 14a of the first cylinder 14 and the top

surface of the support structure 12. By this slit 15 it is assured that a pressure medium can pass under the horizontal arm 14a of the first cylinder 14 up to the seal 17. However, there will remain a sufficient support surface for the seal 17 on both the inner and the outer circumference. Thus, this embodiment has the same basic idea as the embodiment shown in Fig. 1, i.e. the pressure medium is effective on the bottom surface of the horizontal arm 14a of the cylinder approximately over an area equal to that in which it is effective on the top surface of the horizontal arm 14a.

Fig. 5 is a schematic view of the structure of the extended nip press shown in Fig. 1, viewed in a direction transverse to the machine direction, in a situation in which the press shoe 11 is loaded with one cylinder row 14. The figure shows how a web W is guided into an extended nip N between a counter roll 50 and a belt shell 30 of a shoe roll. The press shoe 11 is supported in the machine direction on the support structure 12 by means of support members 41, 42 provided on both sides of the loading member 11. The support members 41, 42 receive the machine direction forces which are caused by the belt shell 30 and the counter roll 50 and which act on the press shoe 11. The first support member 42 in the operating direction S of the machine is not necessary because, in the operating state, friction force urges the press shoe 11 against the support member 41 at the outlet edge.

Fig. 6 is a schematic view of a third embodiment of the structure of the extended nip press according to the invention, viewed in a direction transverse to the machine direction. In this embodiment, a piston 120 is not attached to the press shoe 11, but the piston 120 is supported at its upper part on a second cylinder 114 which is attached to the press shoe 11. The second cylinder 114 is formed of a bottom plate 114a and a cylinder sleeve 114b. The bottom plate 114a is supported on the bottom surface of the press shoe 11 by means of a flange 113 surrounding the bottom plate 114a, and the flange 113 is attached to the bottom surface of the press shoe 11 by attachment means 21, for example, by bolts. In this embodiment, the piston 120 comprises a lower portion 122 provided with a spherical side

surface and an upper portion 123 provided with a spherical side surface as well as an intermediate portion 121 connecting these. The lower portion 122 of the piston 120 is disposed in the first cylinder 14 so as to be sealed against it by means of an annular seal 124 provided at the widest point of the spherical side surface of the lower portion 122. The upper portion 123 of the piston 120 is in turn disposed in the second cylinder 114 so as to be sealed against it by means of an annular seal 125 provided at the widest point of the spherical side surface of the upper portion 123. The intermediate portion 121 is formed here of a cylindrical sleeve. The lower part 122 of the piston 120 is locked against sliding out of the first cylinder 14 by means of a lock ring 160 which is disposed against the end surface of the vertical arm 14b of the first cylinder 14 and which is attached to said end surface by attachment means, for example, by bolts 161.

Because of the spherical side surface of the lower portion 122 and the upper portion 123 of the piston 120, the piston 120 can incline with respect to the first 14 and the second 114 cylinder. This structure allows an inclination of the piston 120 in a range of about 3-5°.

The press shoe 11 is supported by means of a support member 130 against machine direction forces S. In addition, a pin 131 is disposed in the press shoe 11, the outer end of the pin being positioned in a slot 132 formed in the support member 130. With this arrangement, the press shoe 11 can move freely in the loading direction against and away from the counter roll 50 while the movement of the press shoe 11 is restricted in a direction transverse to the machine direction S.

A flange 150 provided with a lubricating oil feed duct 151 is attached to the edge of the press shoe 11 opposite to the support member 130. Lubricating oil is fed from said feed duct 151 into an oil pocket 140 provided in the press shoe 11 through bores 141 formed in the press shoe 11.

A pressure medium is passed into a pressure chamber 118 defined by the first cylinder 14, the second cylinder 114 and the piston 120 situated inside them from a pressure medium flow opening 23 provided in the support structure 12. The first cylinder and the support structure associated therewith correspond here to the embodiment shown in Fig. 3, but it is, of course, also possible to use here the embodiment shown in Fig. 1.

The upper end and the lower end of the piston 120 may also be closed by means of end plates, in which connection a first pressure chamber is formed in the space defined by the first cylinder 14 and the lower end plate of the piston 120 and a second pressure chamber is formed in the space defined by the second cylinder 114 and the upper end plate of the piston 120. The first and the second pressure chamber can be connected by means of a pressure medium duct which extends through the piston 120 and through which the pressure medium supplied into the pressure chamber under the piston 120 gets into the pressure chamber above the piston 120. The press shoe 11 may also be provided with a pressure medium feed duct having flow openings into the second cylinder 114. In that connection, communication between the pressure chambers can be arranged by means of connecting ducts between the support structure 12 and the press shoe 11.

Fig. 7 is a schematic view of the structure of the extended nip press shown in Fig. 1, viewed in a direction transverse to the machine direction, in a situation in which the press shoe 11 is loaded with two cylinder rows 300, 400. The only difference with respect to the situation of Fig. 5 is that here two cylinder rows 300, 400 spaced from each other in the machine direction are used instead of one cylinder row. The cylinders of both cylinder rows 300, 400 with their support structures fully correspond to the structure illustrated in Figs. 1, 2 and 5. It is, of course, also possible to use the alternative shown in Figs. 3, 4 or 6. When there are two cylinder rows, unequal pressures can be used in them and the shape of the compression pressure curve can be regulated in them.

In the arrangement according to the invention, the pressure medium which loads the press shoe 11 is the same pressure medium as is also used for relieving the first cylinder 14. Thus, the relief of the first cylinder 14 is independent of the loading situation at each particular time. The same pressure medium affects the upper surface in the pressure chamber 18, 118 of the horizontal arm 14a of the first cylinder 14 and the lower surface defined by the seal 17 of the horizontal arm 14a of the cylinder with the same pressure. As said areas are equal, the first cylinder 14 is fully relieved at all times, with the result that the first cylinder 14 can move with a very low friction in a plane perpendicular to the centre axis Y2 of the first cylinder 14.

The claims are presented in the following and the various details of the invention may vary within the inventive idea defined by said claims and differ from those described above by way of example only.

Claims

1. An extended nip press for a paper or board machine in which an extended nip (N) is formed between a counter roll (50) and a shoe roll (10), which shoe roll (10) comprises a stationary support structure (12), a flexible shell (30) which rotates around it and which is supported at its inner surface on the support structure (12) by means of a press shoe (11) and associated loading members (14, 20, 114, 120) spaced from one another in a direction transverse to the machine direction and situated in at least one row, which loading members (14, 20, 114, 120) comprise a first cylinder (14) supported on the support structure (12) and a piston (20, 120) disposed in the first cylinder and supported directly or indirectly on the press shoe (11), in which connection the press shoe (11) and the shell (30) surrounding it can be loaded against the counter roll (50) by means of said loading members (14, 20, 114, 120), **characterised** in that the first cylinder (14) is disposed in a cylindrical base part (13) so as to be movable in a plane perpendicular to the centre axis (Y2) of the first cylinder (14), which base part (13) is attached to the support structure (12), and that the first cylinder (14) is relieved in the radial direction by means of a pressure medium supplied into a pressure chamber (18, 118) of the first cylinder (14), by which pressure medium the press shoe (11) is also loaded.

2. An extended nip press according to claim 1, **characterised** in that the piston (20) directly supported on the press shoe (11) comprises a portion (20a) attached to the press shoe (11) in a stationary fashion and a portion (20b) under it provided with a spherical side surface, which portion (20b) is disposed in the first cylinder (14) by means of an annular seal (19) provided in the spherical side surface.

3. An extended nip press according to claim 1, **characterised** in that the piston (120) indirectly supported on the press shoe (11) comprises a lower portion (122) which is provided with a spherical side surface and disposed in the first cylinder (14) so as to be sealed against it by means of an annular seal (124) provided in the

spherical side surface, and an upper portion (123) which is provided with a spherical side surface and disposed in a second cylinder (114) attached to the bottom surface of the press shoe (11) so as to be sealed against the second cylinder by means of an annular seal (125) provided in the spherical side surface, as well as an intermediate portion (121) connecting the lower portion (122) and the upper portion (123).

4. An extended nip press according to any one of claims 1 to 3, **characterised** in that the cross section of the wall of the first cylinder (14) is substantially in the shape of an inverted letter T comprising a horizontal arm (14a) and a vertical arm (14b), and that the base part (13) comprises a cylindrical portion (13b) surrounding the horizontal arm (14a) of the first cylinder (14) at a distance, which cylindrical portion (13b) is supported on the top surface of the support structure (12), and an annular portion (13a) positioned on the horizontal arm (14a) of the first cylinder (14), which annular portion (13a) is supported on the top surface of the cylindrical portion (13b), in which connection the annular portion (13a) of the base part (13) prevents radial movement of the first cylinder (14) and the cylindrical portion (13b) of the base part (13) allows movement of the first cylinder (14) in a plane perpendicular to the centre axis (Y2) of the first cylinder (14).

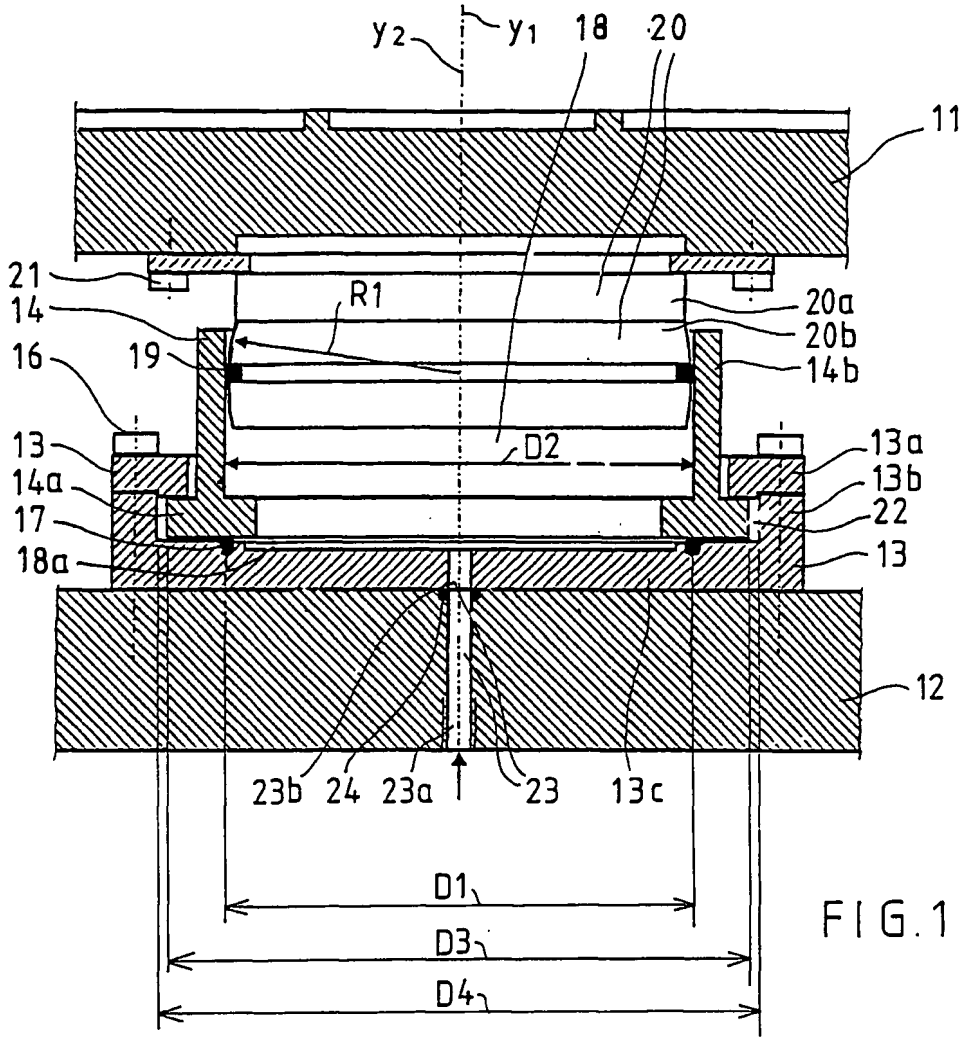
5. An extended nip press according to claim 4, **characterised** in that the base part (13) additionally comprises a bottom plate (13c) which closes the lower end of the cylindrical portion (13b) of the base part (13) and which has a cylindrical recess (18a) which extends some distance under the horizontal arm (14a) of the wall of the first cylinder (14) disposed in the base part (13), and that the horizontal arm (14a) is sealed by means of an annular seal (17) against the surface surrounding the cylindrical recess (18a) of the bottom plate (13c), in which connection a pressure medium is introduced into said recess (18a) from a flow opening (23b) extending through the bottom plate (13c), from which recess the

pressure medium spreads into the pressure chamber (18, 118) and to the area defined by the seal (17) under the horizontal arm (14a) of the first cylinder (14).

6. An extended nip press according to claim 4, **characterised** in that the horizontal arm (14a) of the cylinder (14) is sealed against the top surface of the support structure (12) by means of an annular seal (17) disposed in the horizontal arm (14a), and that a slit (15) extending to the seal (17) is formed between the bottom surface of the horizontal arm (14a) and the top surface of the support structure (12), in which connection a pressure medium is introduced from a pressure medium duct (23) provided in the support structure (12) into the pressure chamber (18, 118), from which the pressure medium also spreads to the area defined by the seal (17) under the horizontal arm (14a) of the first cylinder (14).

7. An extended nip press according to any one of claims 4 to 6, **characterised** in that the inside diameter (D4) of the cylindrical portion (13b) of the base part (13) is advantageously about 6 to 10 mm larger than the outside diameter (D3) of the horizontal arm (14a) of the first cylinder (14) disposed in the base part (13).

8. An extended nip press according to any one of claims 5 to 7, **characterised** in that the relationship between the effective sealing diameter (D1) of the seal (17) between the horizontal arm (14a) of the first cylinder (14) and the bottom plate (13c) of the base part (13) or the top surface of the support structure (12) and the inside diameter (D2) defined by the vertical arm (14b) of the first cylinder (14) is in a range of ± 10 %, advantageously in a range of ± 5 %.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y1
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20
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16
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D2
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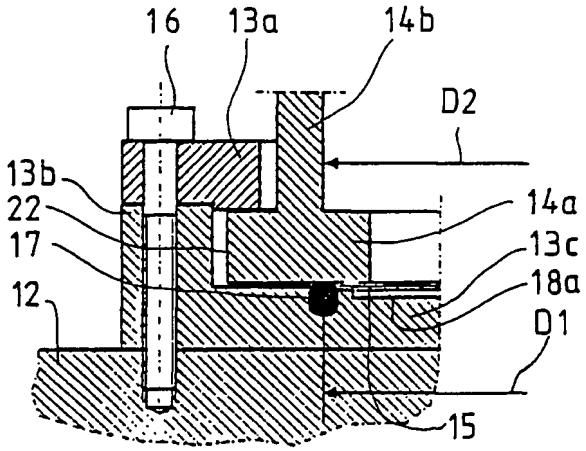
12
23b
24
23a
23
13c
D1
D3
D4

FIG.1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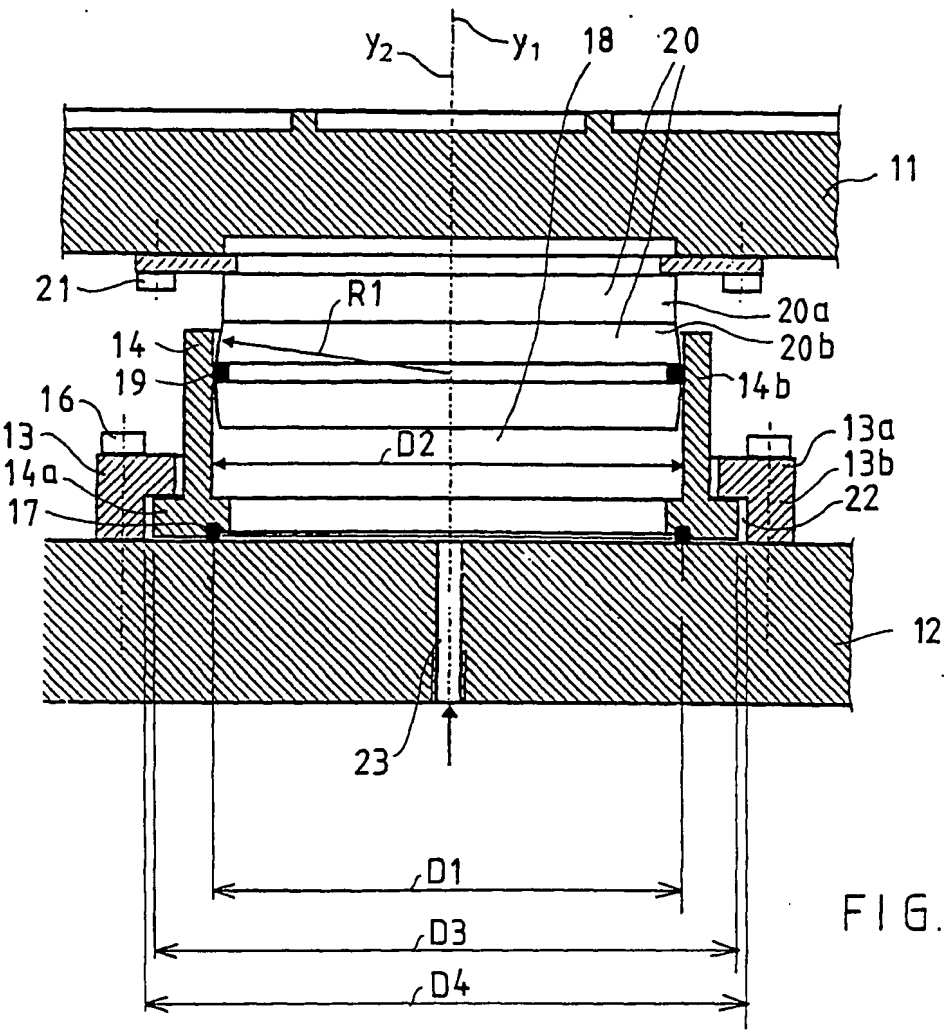
14b
D2
13b
22
14a
17
13c
18a
12
D1
15

FIG.2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11
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R1
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14a
13b
17
22
12
23
D1
D3
D4

FIG. 3

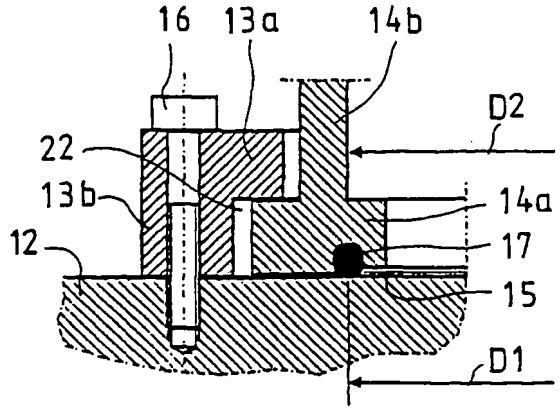
16
13a
14b
D2
22
13b
14a
12
17
15
D1

FIG. 4

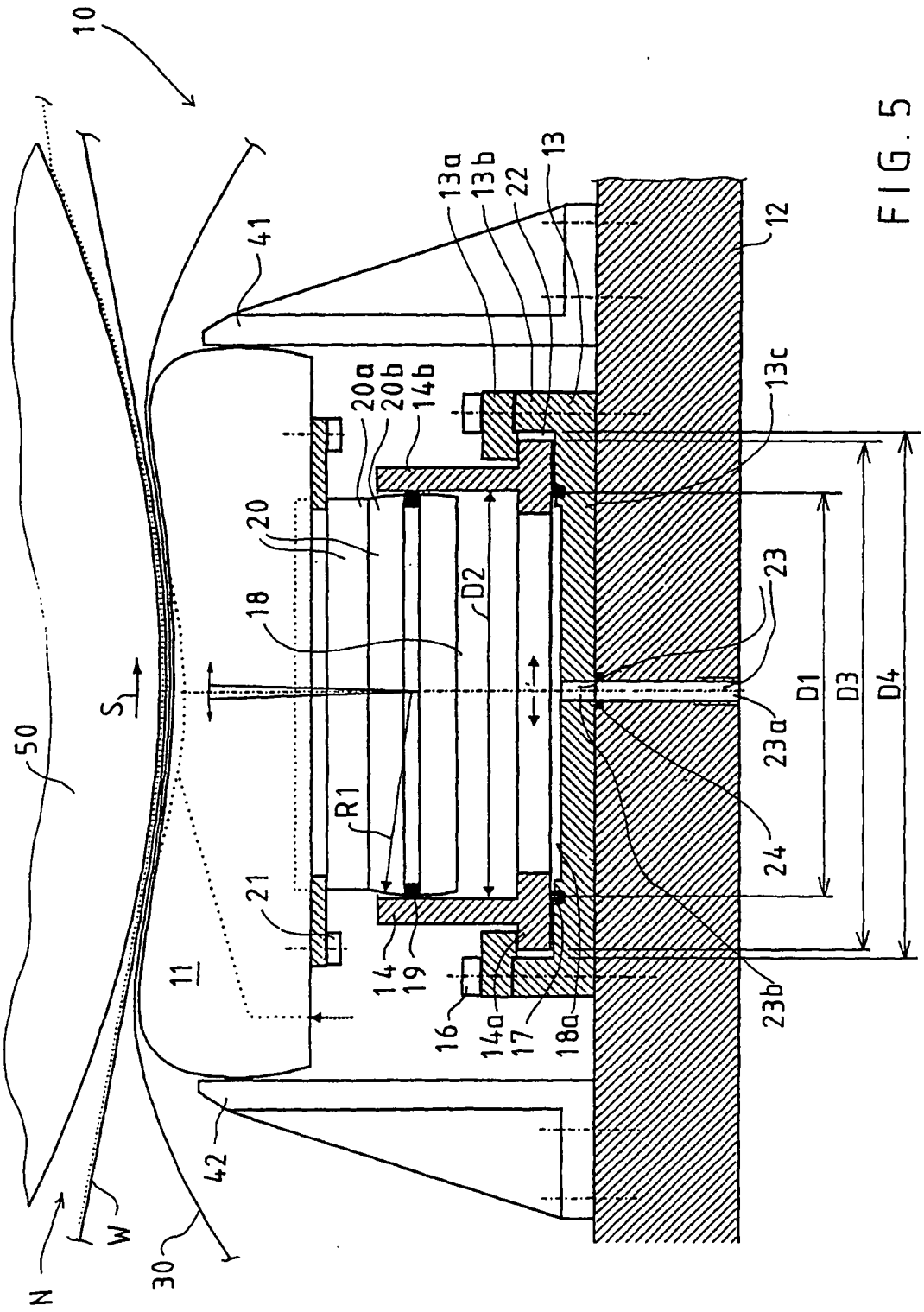
10
41
13a
13b
22
13
12
13c
20a
20b
14b
20
18
D2
23
D1
D3
D4
23a
24
23b
50
S
R1
21
11
14
19
16
14a
17
18a
42
W
30
N

FIG. 5

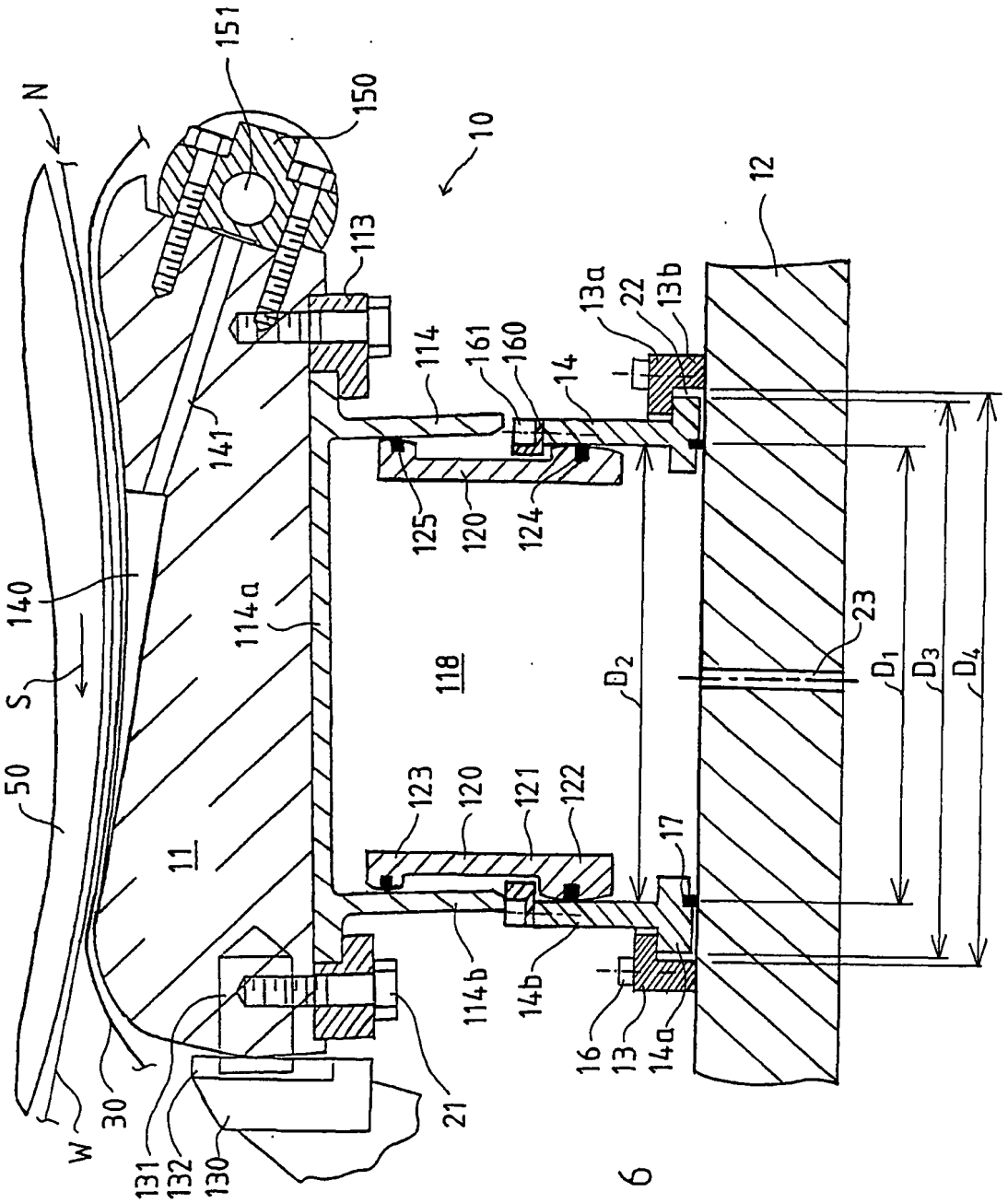
N
151
150
10
113
12
13a
22
13b
114
161
160
14
141
125
120
124
140
114a
118
23
S
50
11
123
120
121
122
17
114b
14b
16
13
14a
30
W
131
132
130
21
D1
D2
D3
D4

FIG. 6

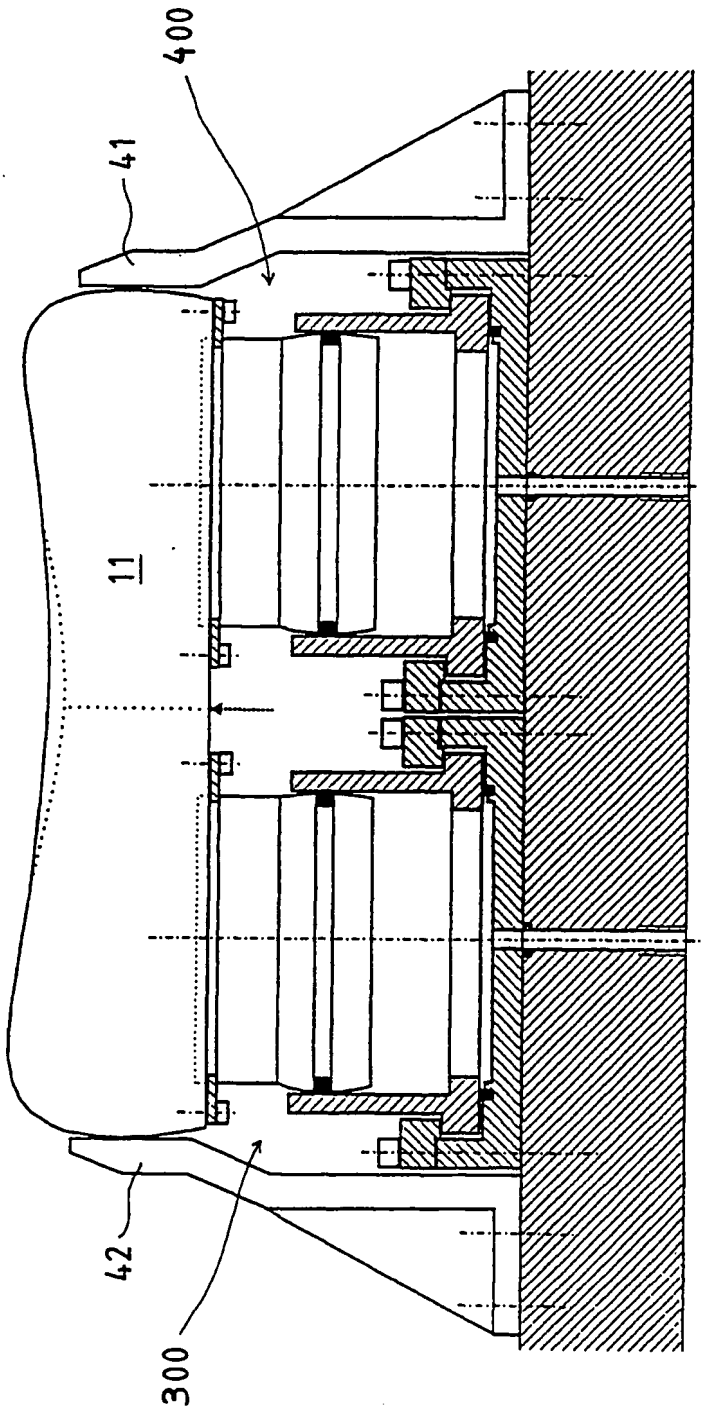

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00568

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21F 3/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9916967 A1 (VALMET-KARLSTAD AB), 8 April 1999 (08.04.99) --	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 Sept 2001	26 -09- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Olov Jensén/ELY Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/09/01

International application No.
PCT/FI 01/00568

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9916967 A1	08/04/99	EP 1027488 A	16/08/00
		SE 510552 C	31/05/99
		SE 9703570 A	31/03/99
		US 6093283 A	25/07/00